Physical Effects of Chemically & Physically Dispersed Oil on Wildlife

This study examines the effects of a marine bird or otter diving through a sub-surface plume of dispersed oil.

The Physical Effects of Chemically and Physically Dispersed Oil on Wildlife

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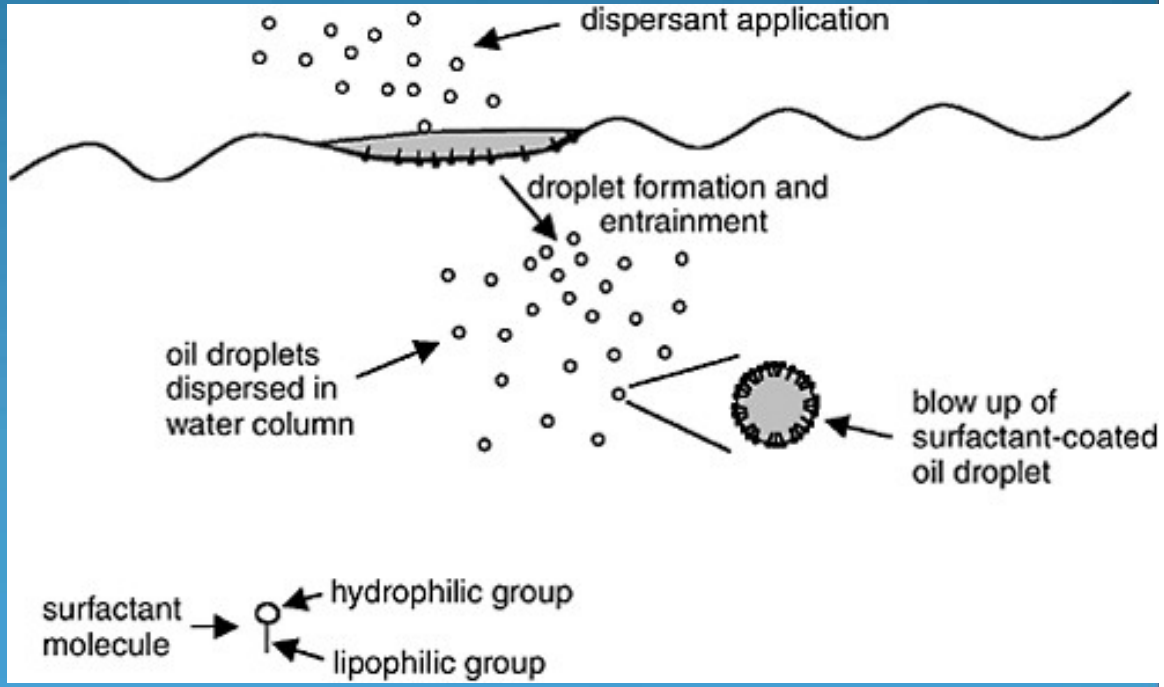
Chemical Dispersants

- Surfactants or solvents that disperse oil into water column
- Applied by aircraft spraying
- Target dilution 1:10 to 1:60 dispersant:oil
- Maximum oil concentration in solution in water column = ~400 ppm



Oil Spill Dispersants: Efficacy and Effects 2005

Tradeoffs of dispersant use

Pro

- Reduce potential impact on water surface wildlife
- Prevent slick reaching sensitive coastal areas

Con

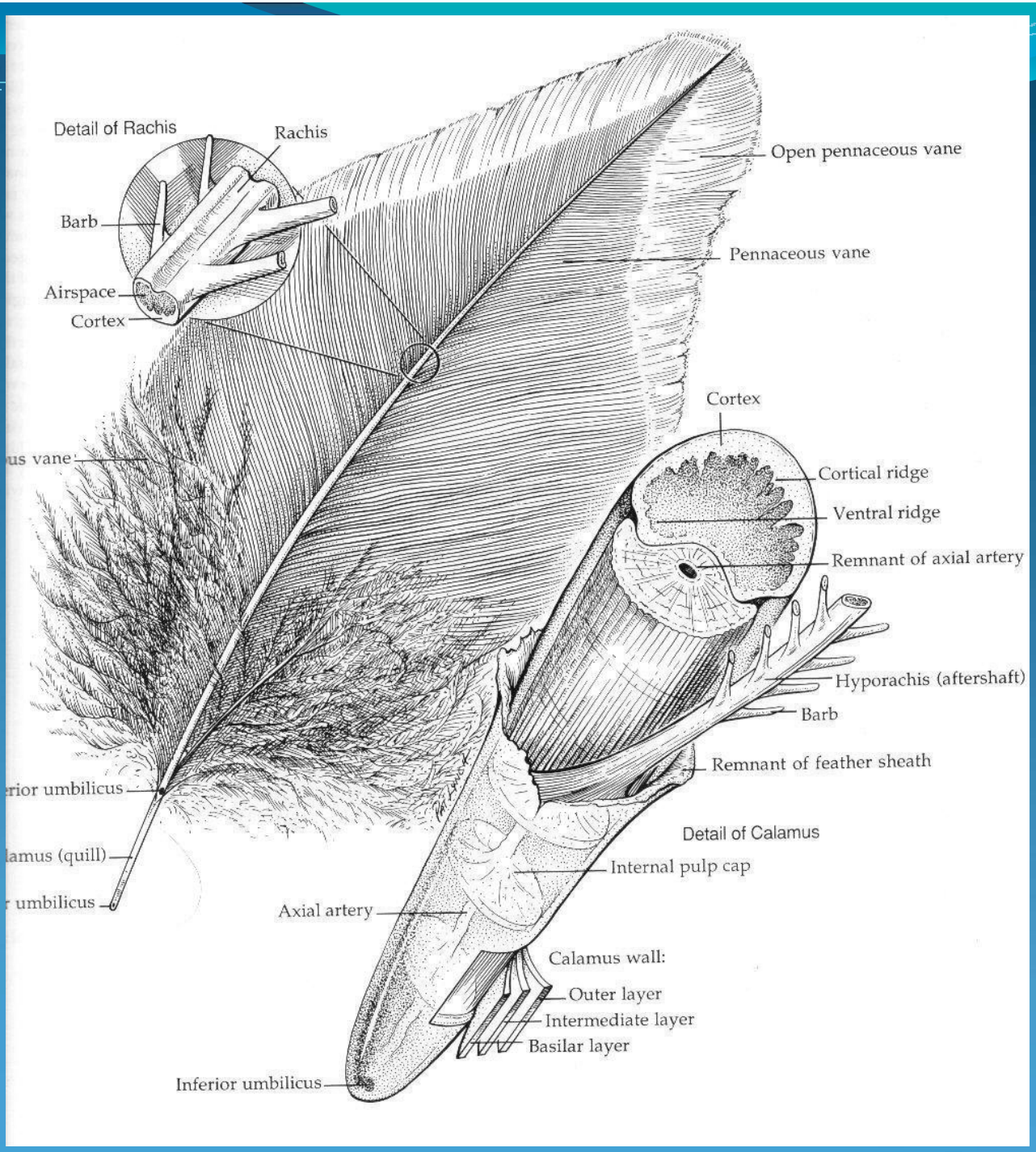
- Increased direct toxicity to water column and benthic organisms
- Limited time frame of utility
- Long term storage and maintenance of ready state over years between events

Study rationale

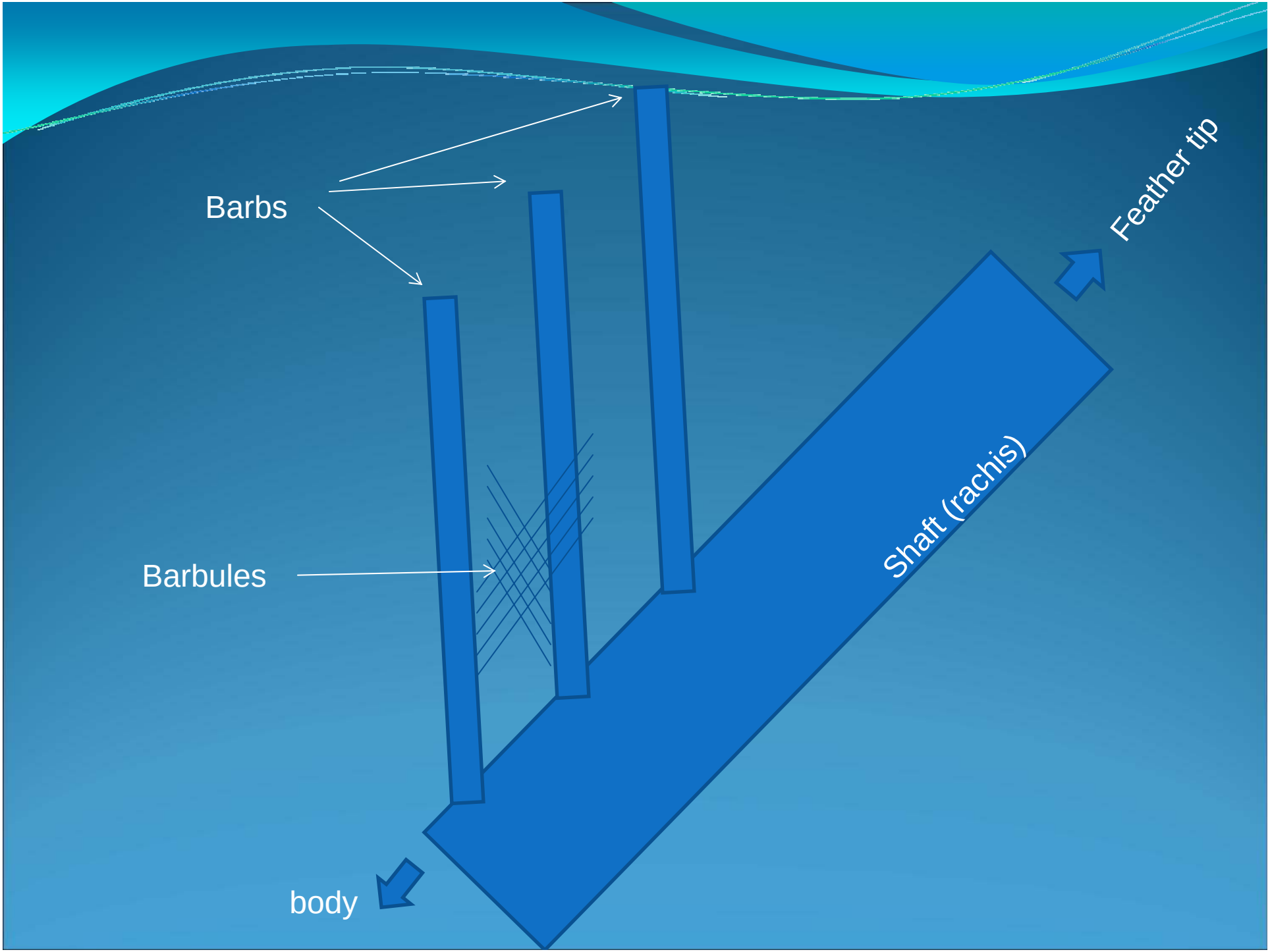
- Pre-approval partly based on assumed benefit to surface vertebrate wildlife
- Limited previous studies of dispersed oil on vertebrate wildlife
- Direct exposure of dispersants to animals is inevitable with application

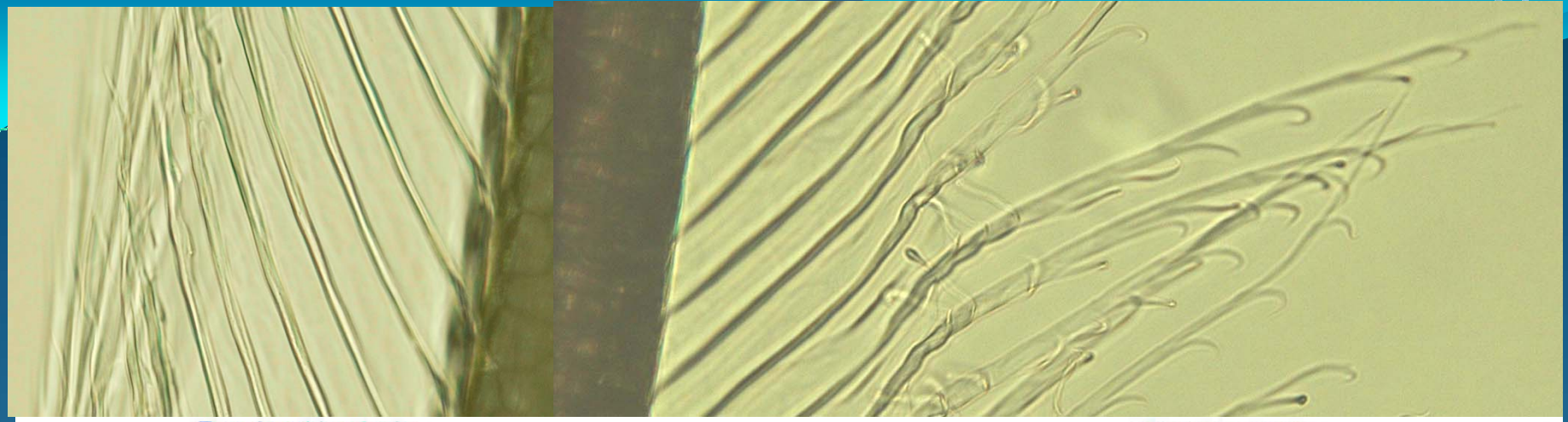
But first: a Feather anatomy primer

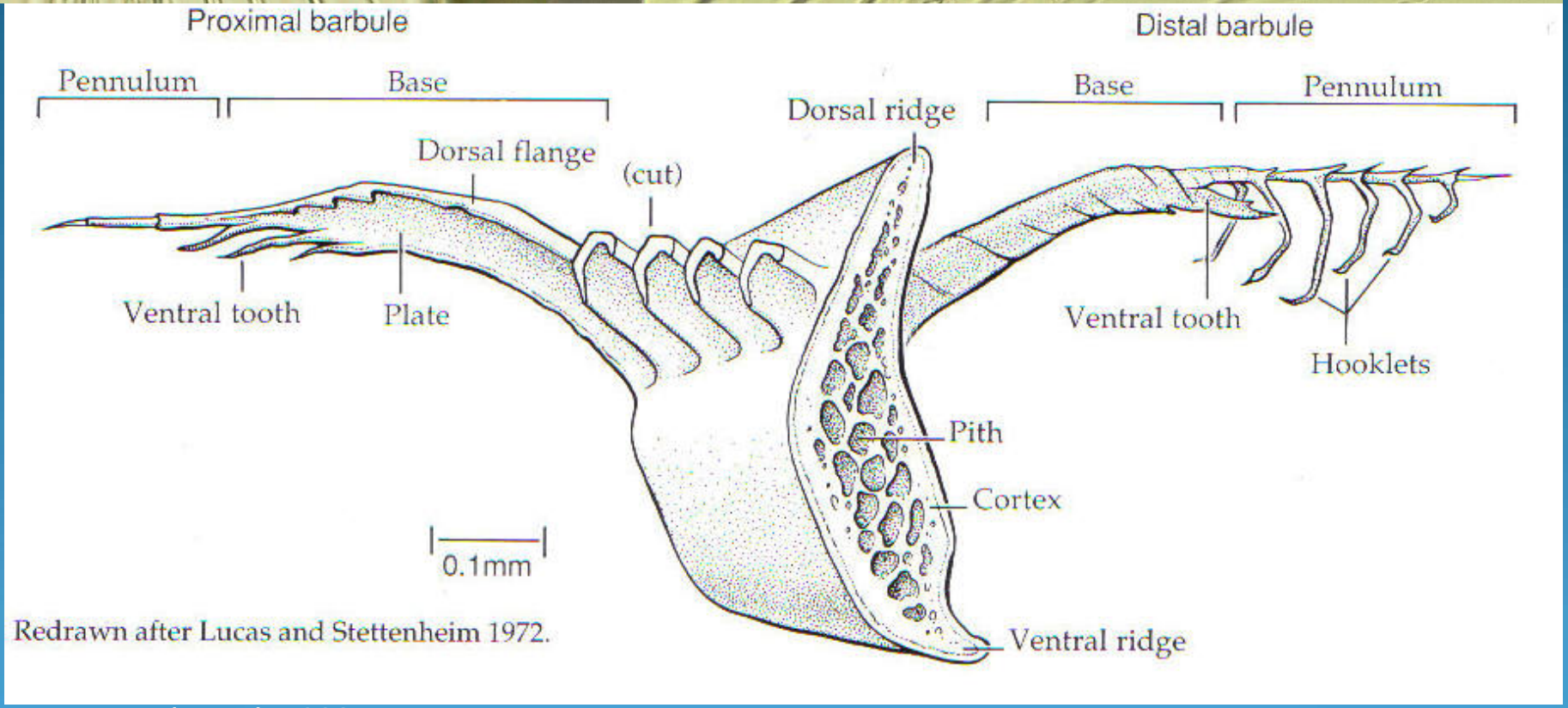
Generic contour feather



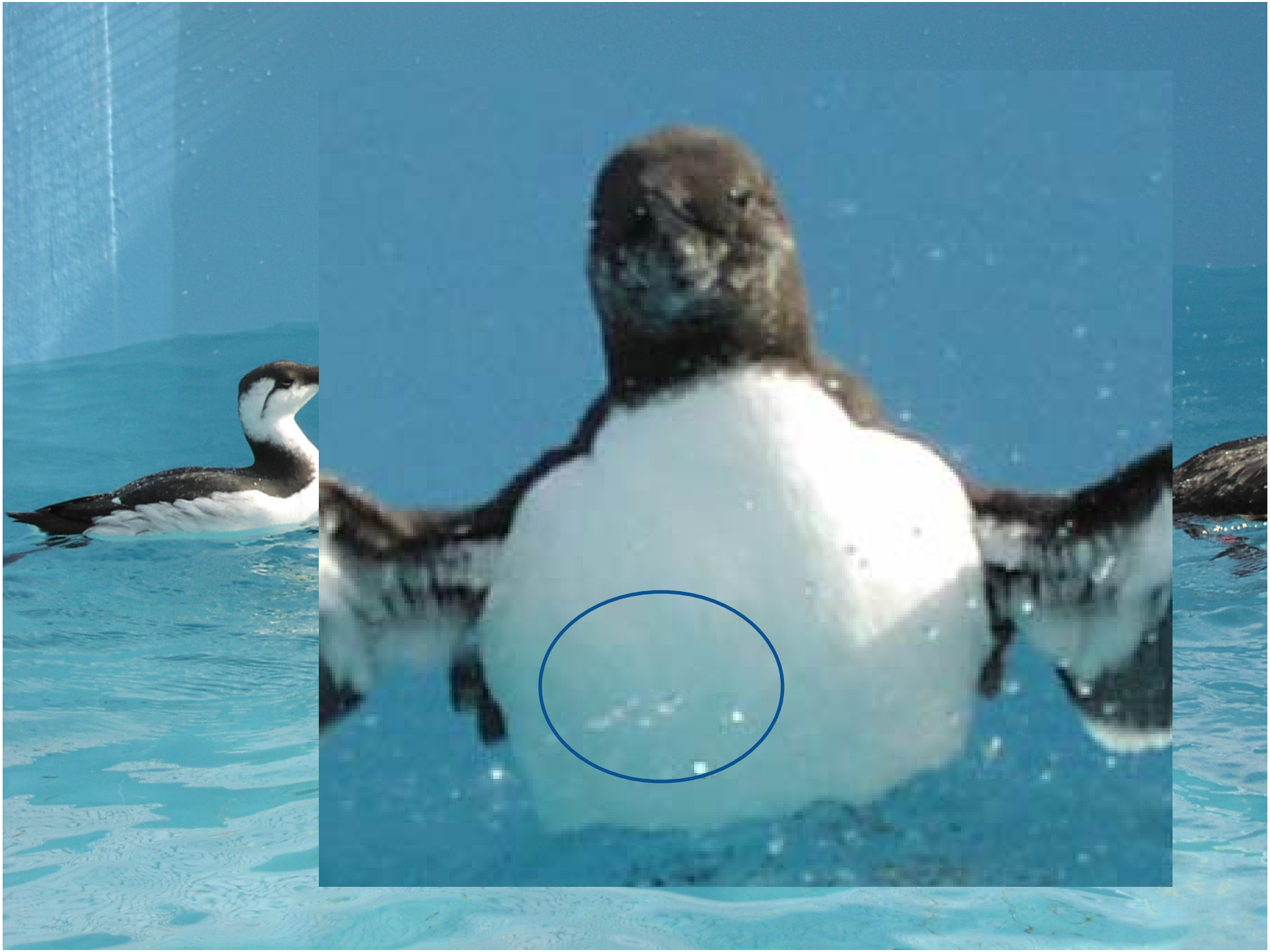
Proctor and Lynch 1993


Barbs
Feather tip
Shaft (rachis)
Barbules
body





Proctor and Lynch 1993



Hypotheses

1. Common murre contour feathers exposed to sea water mixed with mechanically dispersed oil, chemically dispersed oil, or dispersant (only) will display significant and dose-responsive alterations in microscopic cohesion of barbs, barbules and hooklets as compared among treatment groups and as compared to control feathers exposed to plain sea water.

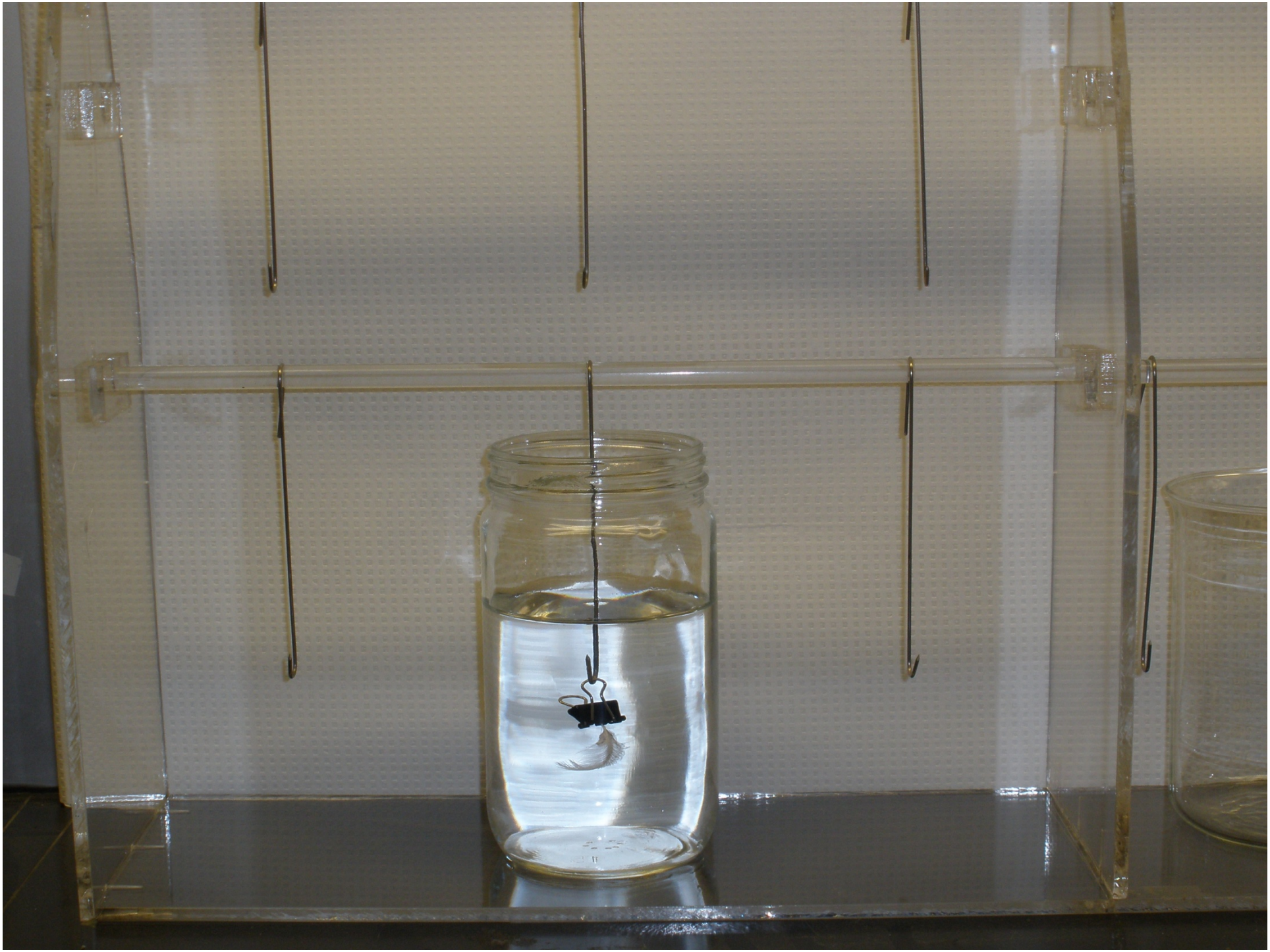
Hypotheses

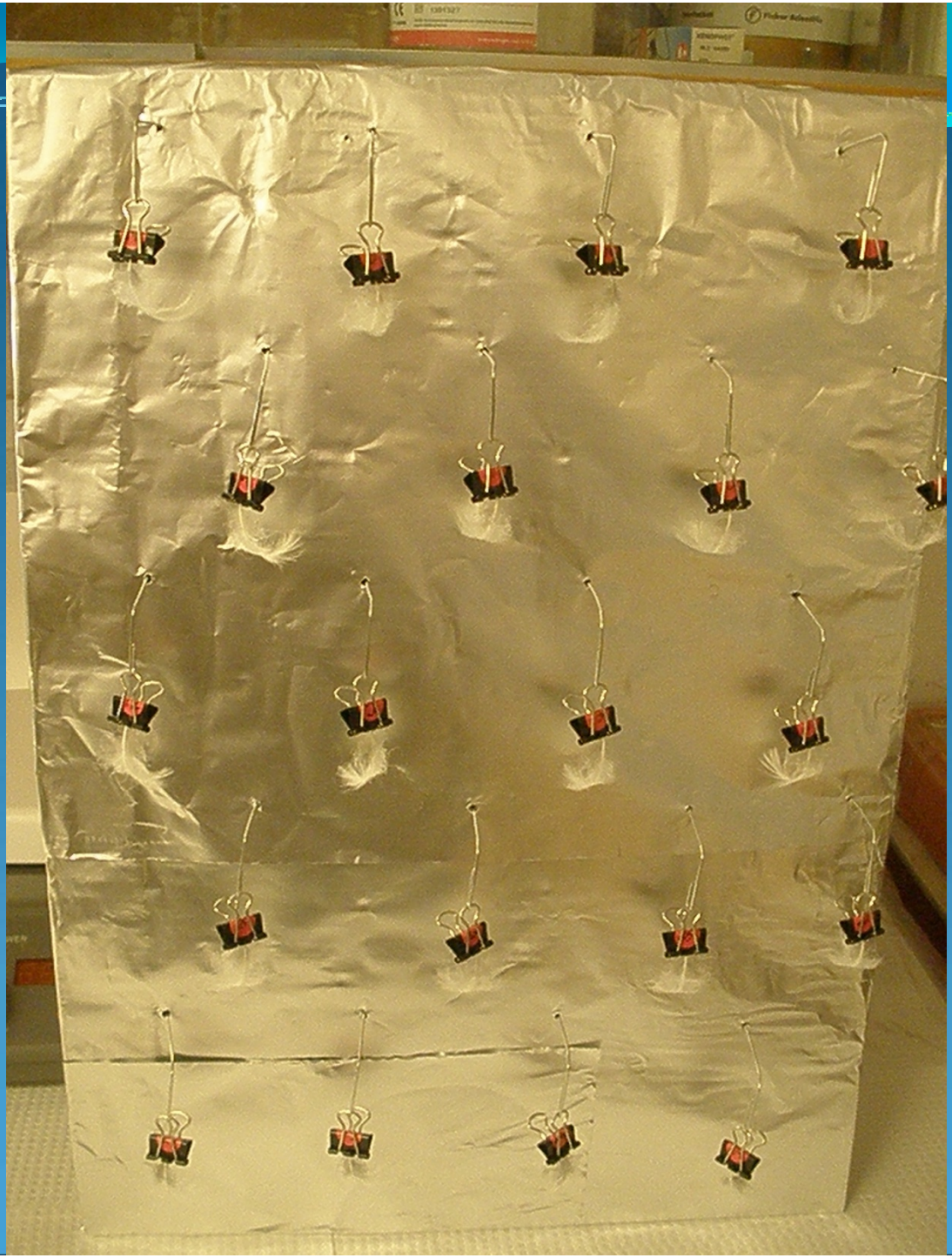
2. Sea otter hair similarly exposed will display visual alteration in structure as compared to control hair exposed to plain sea water
3. Quantified total petroleum hydrocarbon (TPH) levels will differ significantly among treatment groups and will display a dose-response relationship to increasing exposure concentrations of oil.

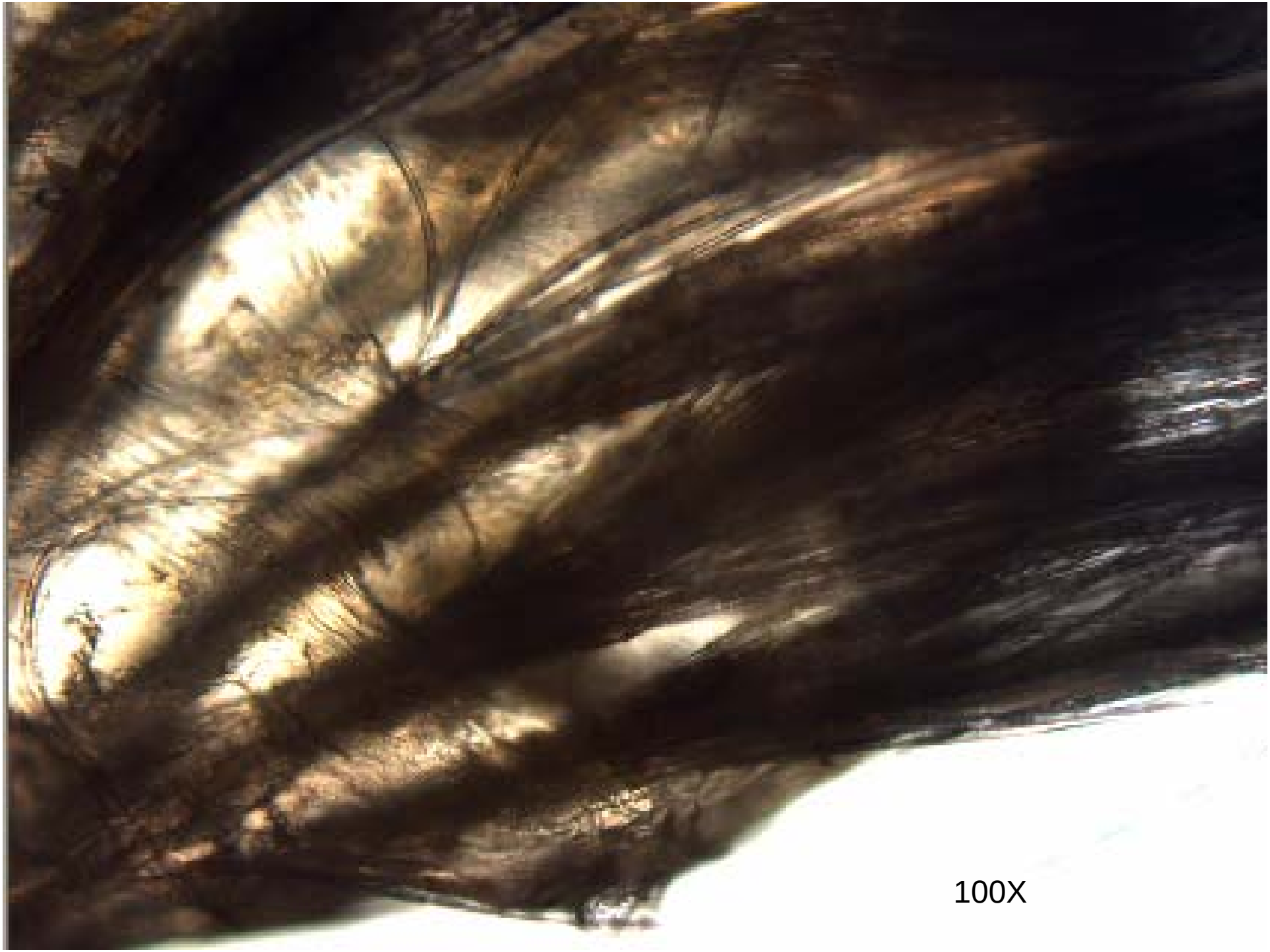
Methods

- Test materials:
  - Alaska North Slope Crude Oil
  - Corexit 9500 (Nalco-Exxon) dispersant
  - Instant Ocean (artificial sea water)
- Test solutions mixed per CROSERF specs

Treatment groups				
	Control	**Dispersant only**	**Oil only**	**Dispersant + oil**
[Low] = 40 ppm	0 Disp + 0 oil/L	2 µL Disp + 0 oil/L	0 Disp + 44 µL oil/L	2 µL Disp + 44 µL oil/L
[Mod] = 200 ppm		11 µL Disp + 0 oil/L	0 Disp + 222 µL oil/L	11 µL Disp + 222 µL oil/L
[High] = 400 ppm		22 µL Disp + 0 oil/L	0 Disp + 444 µL oil/L	22 µL Disp + 444 µL oil/L



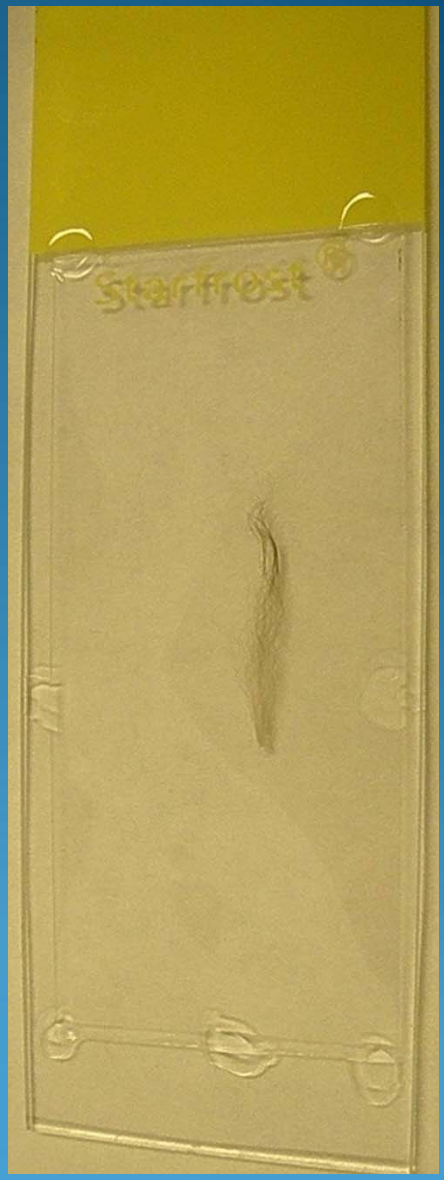




100X


Starfrost ®


Starfrost ®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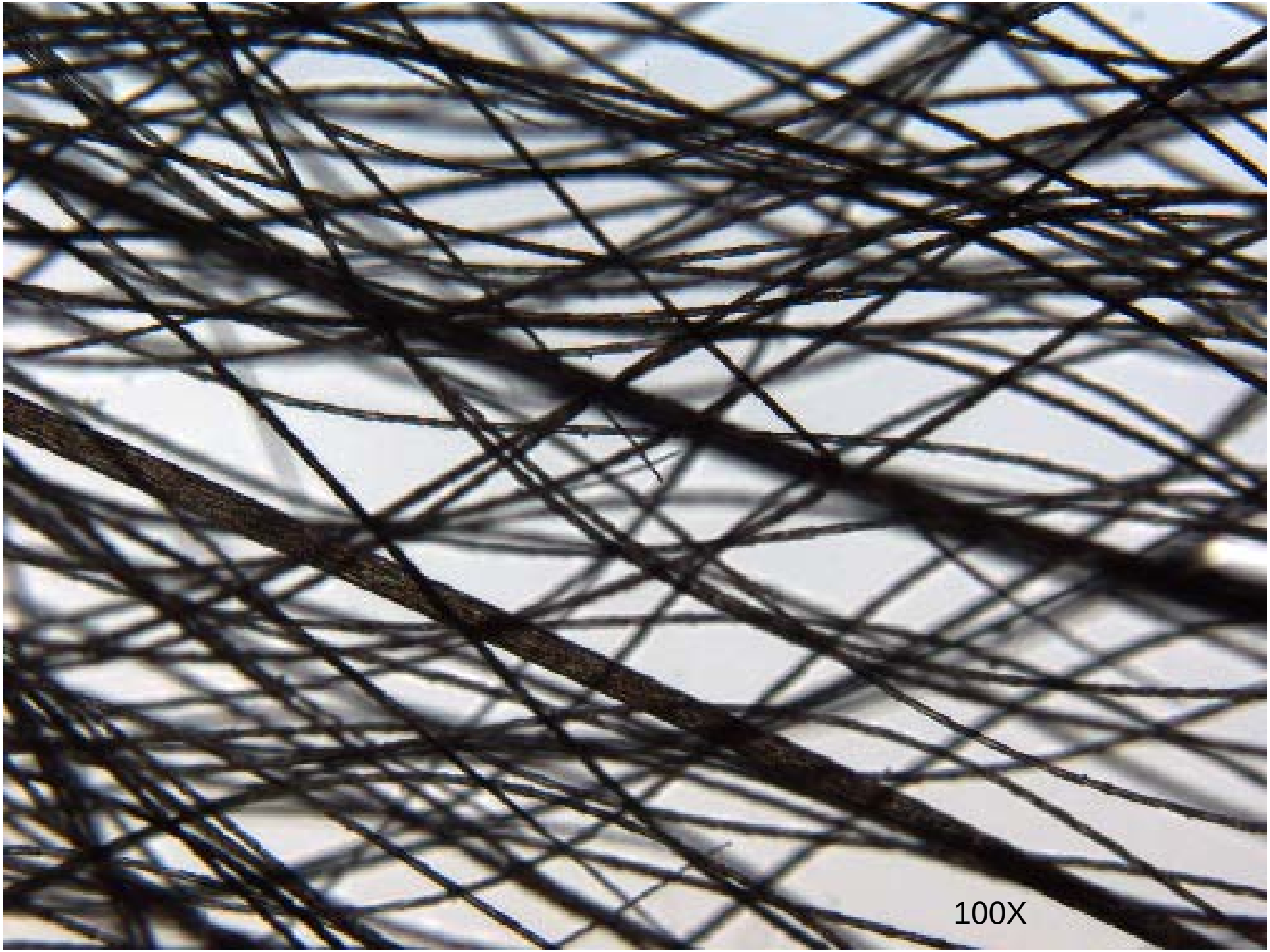
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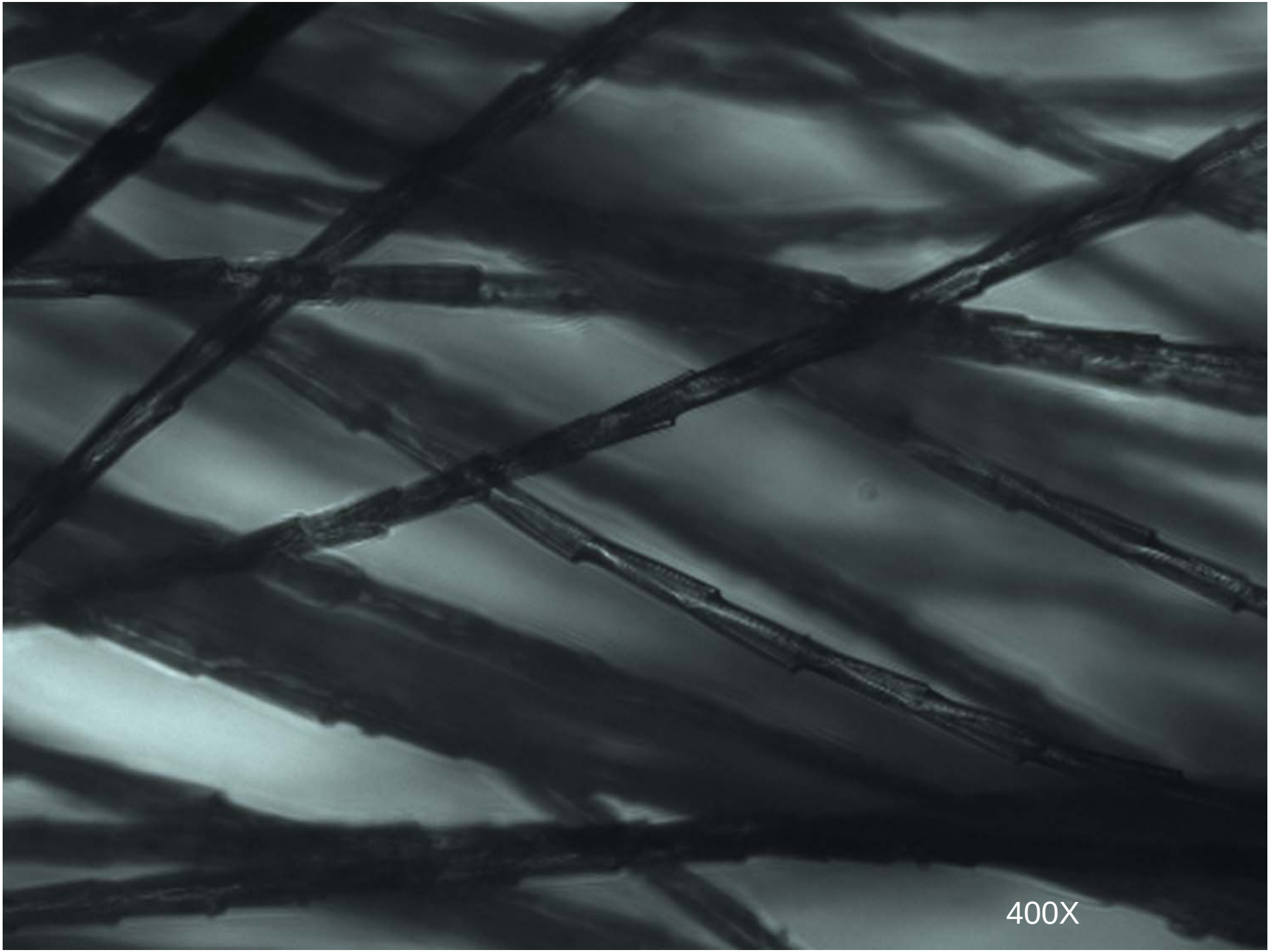
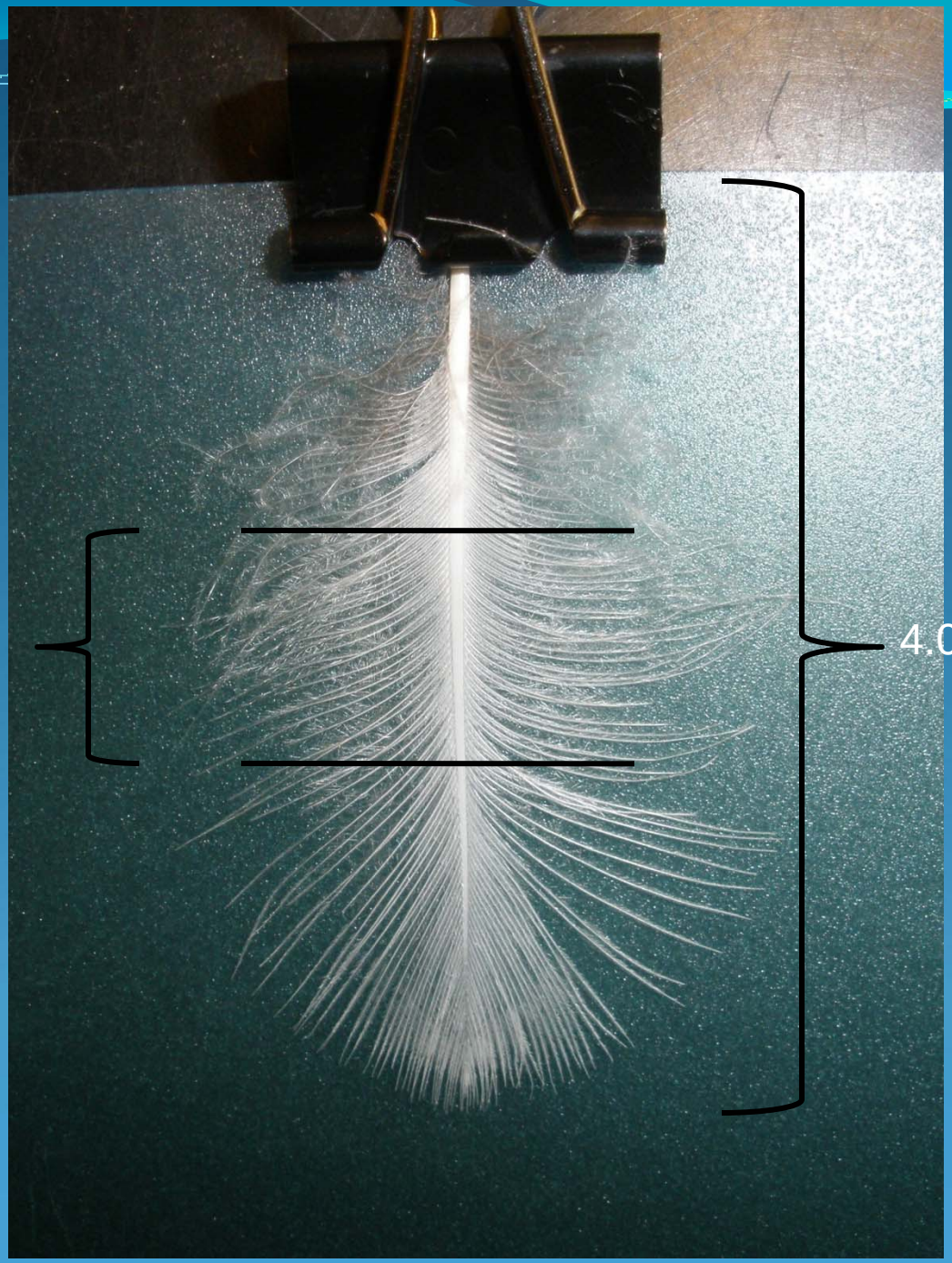
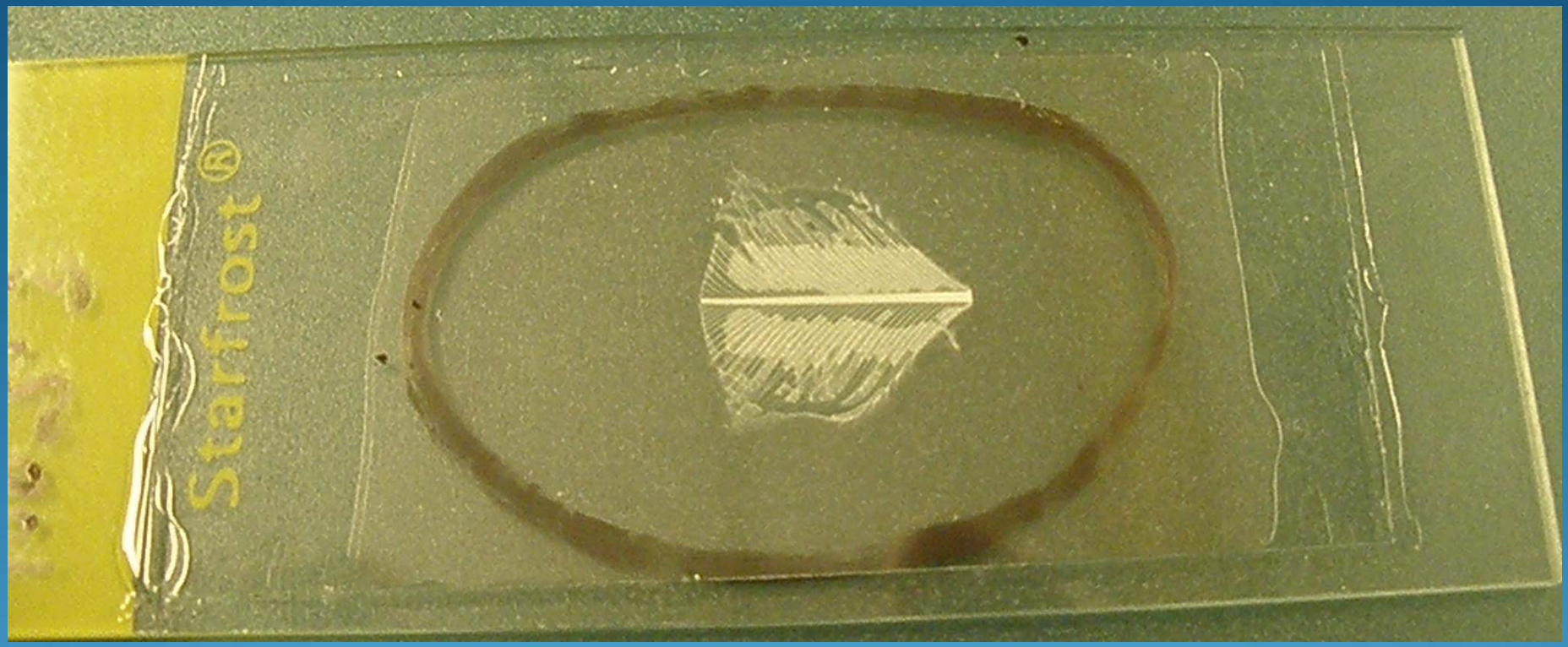

400X


1000X

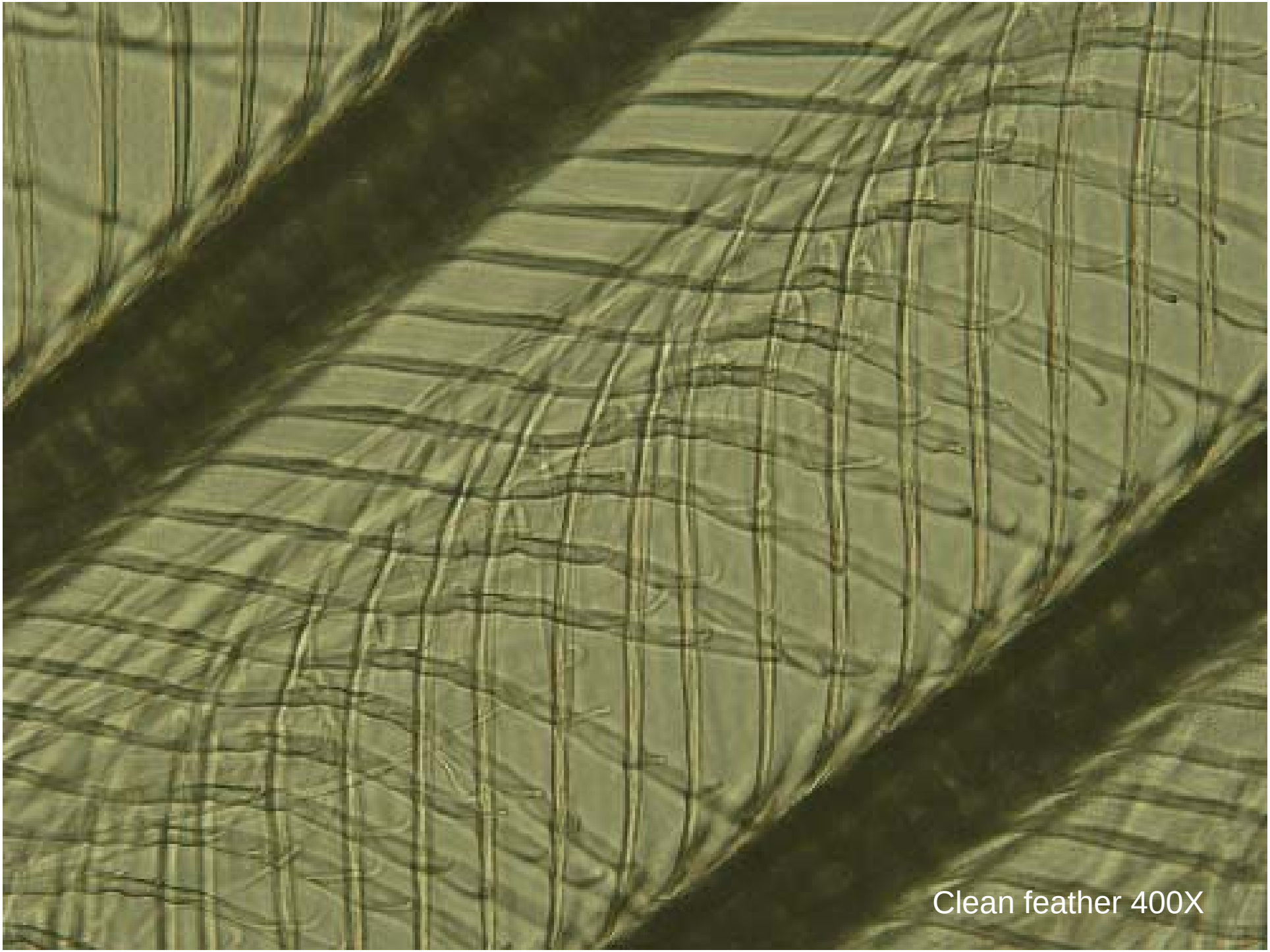
1 cm central area for microscopy

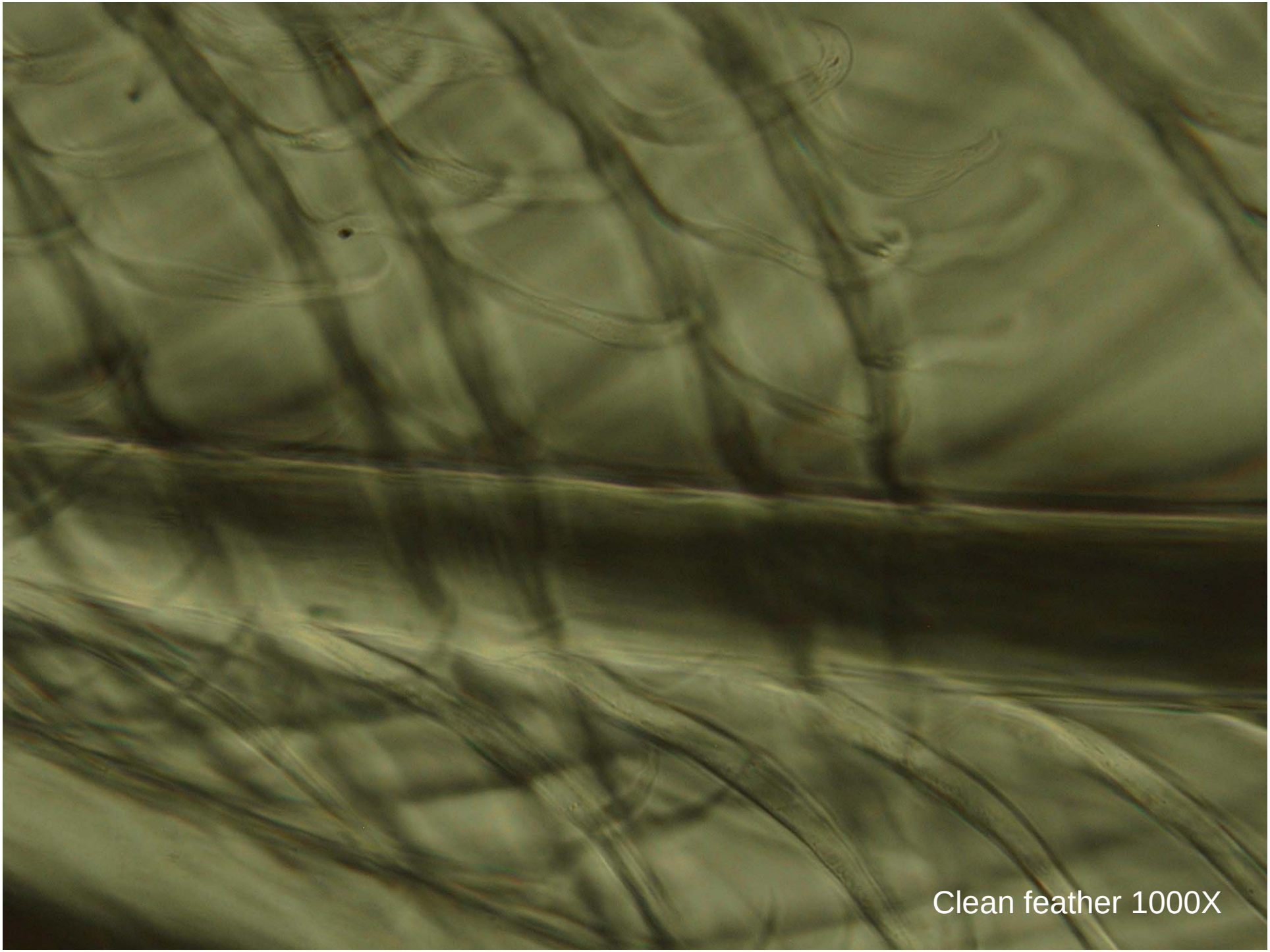


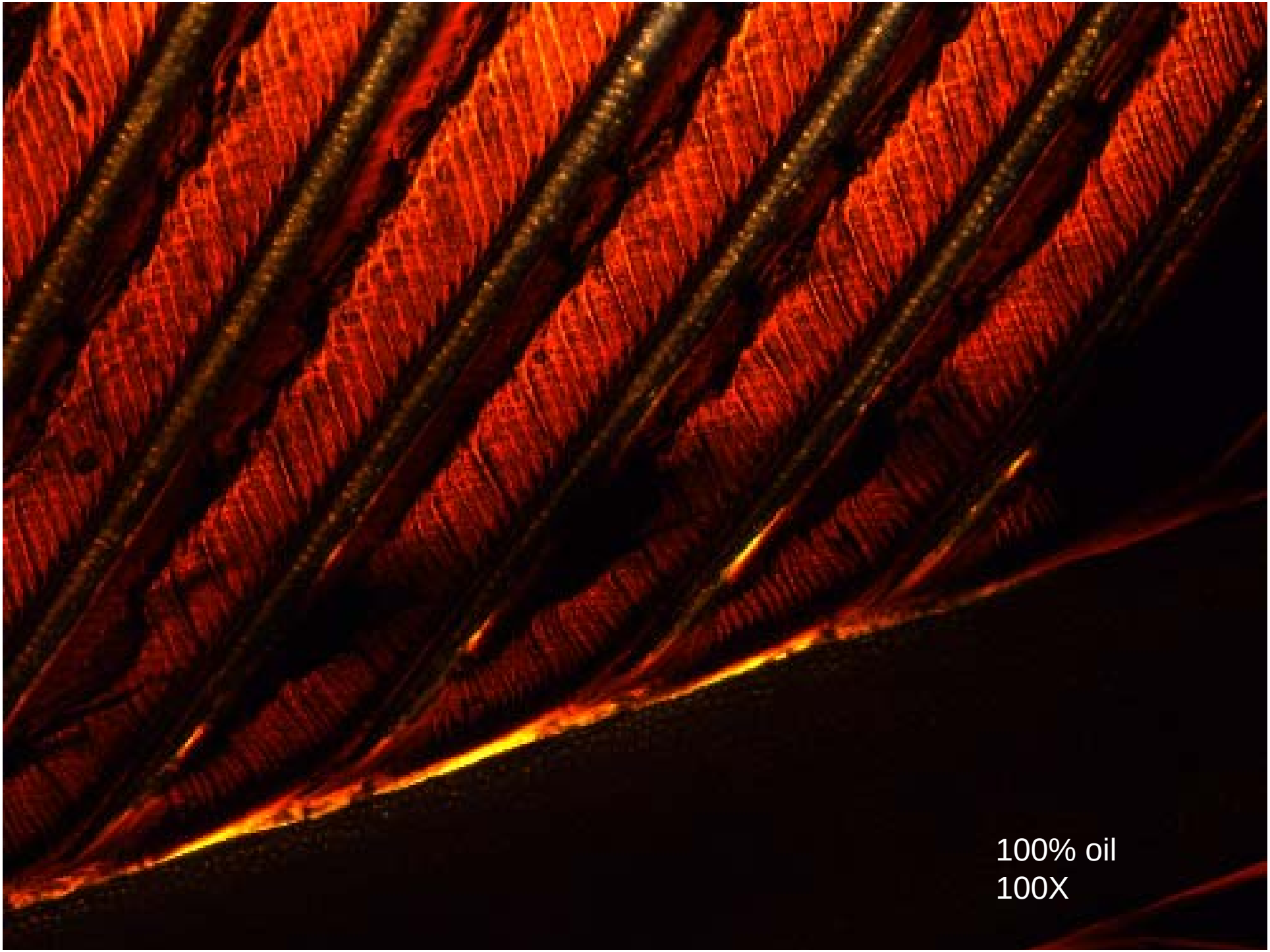
4.0 cm total length

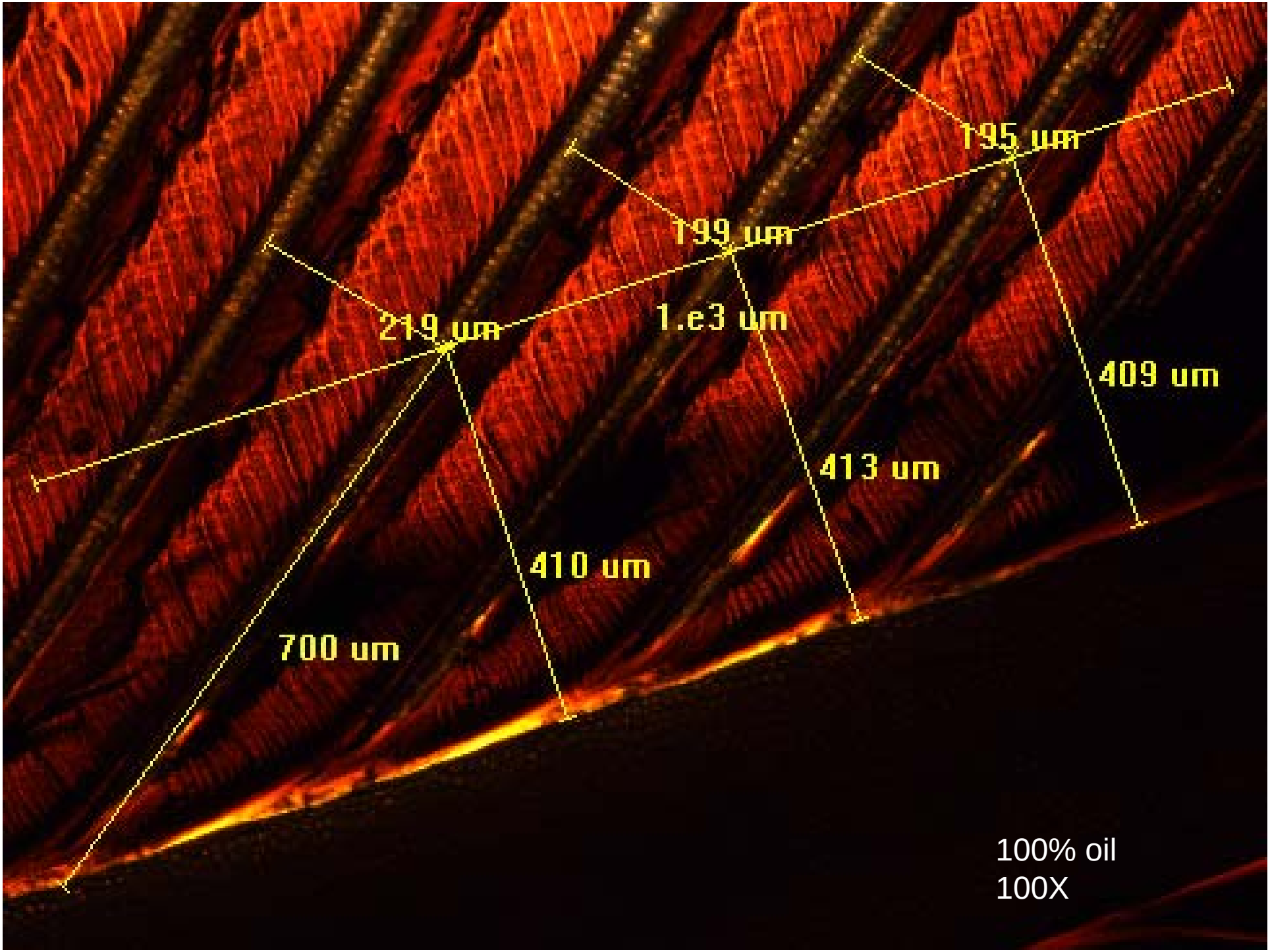

Starfrost ®

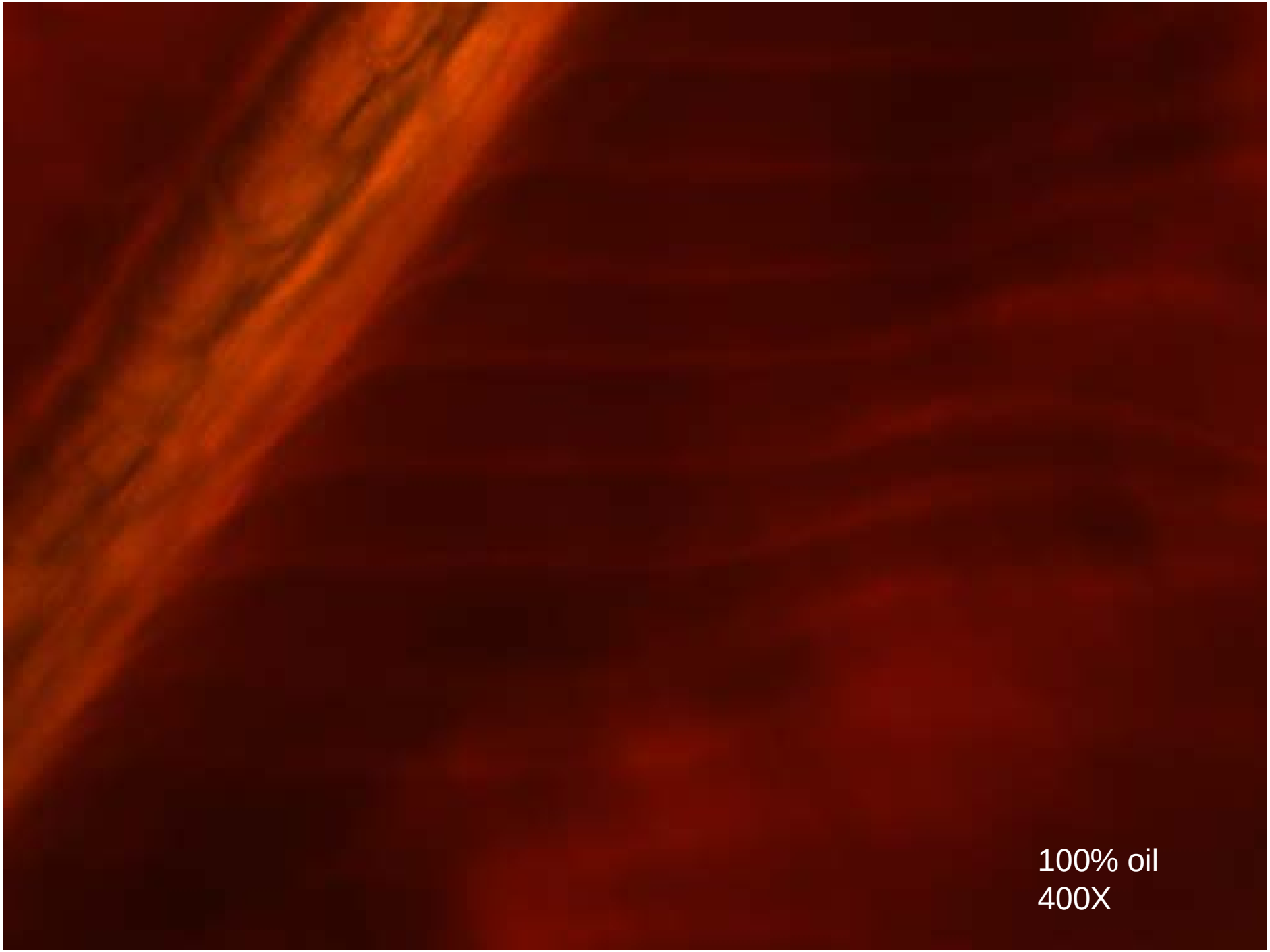

Clean feather 100X

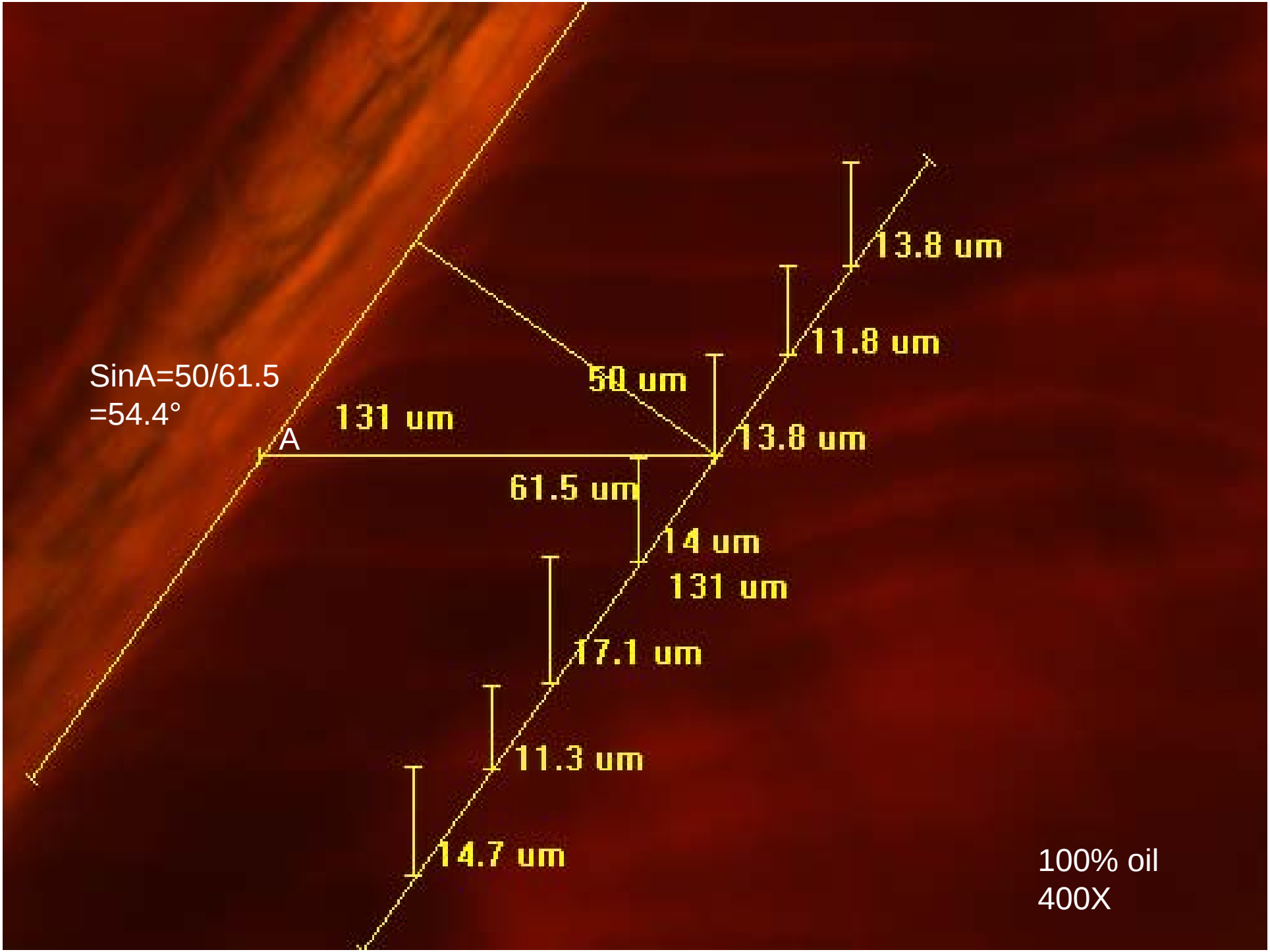

Clean feather 400X


Clean feather 1000X


100% oil
100X


195 um
199 um
219 um
1.e3 um
409 um
413 um
410 um
700 um
100% oil
100X


100% oil
400X


SinA=50/61.5
=54.4°
A
131 um
50 um
13.8 um
11.8 um
13.8 um
61.5 um
14 um
131 um
17.1 um
11.3 um
14.7 um
100% oil
400X

Project Timeline

- June: exposure trials and sample photography
- July-Aug: photographic and numeric data analysis

Future Directions

- Effects of exposure on penetration pressure of whole pieces of pelt
- Effects of surface tension on barbule friction and air bubble formation
- 3D relationship of adjacent feathers

References

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- Pond, R.G. Aurand, and J.A. Kraly (compilers). 2000. Ecological Risk Assessment principles applied to oil spill response planning in the San Francisco Bay area. California Office of Spill Prevention and Response, Sacramento, CA. 70 + App.

Questions?